TOWARDS CALIBRATING THE VESTAN REGOLITH: CORRELATING THE PETROLOGY, CHEMISTRY AND SPECTROSCOPY OF HOWARDITES.

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Introduction: The Dawn spacecraft carries a visible and infrared mapping spectrometer (VIR) [1] that has acquired spectra for the wavelength range 0.25-5.0 μm at various spatial resolutions covering much of the vestan surface [2]. Through comparison of VIR spectra with laboratory spectra of howardite, eucrite and diogenite meteorites, the distribution of more diogenite-rich and more eucrite-rich terranes on Vesta have been mapped [3], but these maps are qualitative in nature. The available laboratory spectra are not well-integrated with detailed sample petrology or composition limiting their utility for lithologic mapping. Importantly, howardites are now recognized to come in two subtypes, regolithic and fragmental [4]. The former are breccias assembled in part from true regolith, while the latter have had much less exposure to the space environment. We are attempting to develop a more quantitative basis for mapping the distribution of lithologic types on Vesta through acquiring laboratory spectra on splits of howardites that have been petrologically and chemically characterized [5]. Noble gas analyses have been done on some allowing identification of those howardites that have been exposed in the true regolith of Vesta [6].

Spectroscopy: Spectra were acquired on sample powders sieved to <75 μm at the spectroscopy laboratory of the Istituto di Astrofisica e Planetologia Spaziali, INAF, and the Keck/NASA Reflectance Experiment Laboratory (RELAB) of Brown University. At present, data-reduction for the new spectra is incomplete and they can only be discussed qualitatively. Band parameters for the ~1 and ~2 μm pyroxene absorption features (hereafter BI and BII) will be computed using the same data-reduction procedures as used for Dawn VIR spectra [3].

Comparisons: There is a general trend indicating that those howardites that were exposed in the true regolith, as indicated by trapped solar wind noble gases [6], show lower reflectance and shallower BI and BII compared to howardites with similar major element compositions, and thus similar eucrite:diogenite mixing ratios [5]. Excluding PRA 04401 which has a very high content of carbonaceous chondrite clasts [5], PCA 02066 has the lowest reflectance and the shallowest BI and BII. This howardite is dominated by melt-matrix breccia clasts, has a high Ni content derived from impactors [5], but it does not contain trapped solar wind gases [6]. Polymict eucrite QUE 97002 (eucrite:diogenite = 96:4 [5]) has lower reflectance and shallower BI and BII than other polymict eucrites. It contains carbonaceous chondrite clasts at ~4 wt% level based on Ni content, but does not contain glassy or melt-matrix clasts [5].

References: [1] De Sanctis M. C. et al. 2011. *Space Science Reviews* 163:329. [2] De Sanctis M. C. et al. 2013. *Meteoritics & Planetary Science*, submitted. [3] Ammannito E. et al. 2013. *Meteoritics & Planetary Science*, submitted. [4] Warren P. H. et al. 2009. *Geochimica et Cosmochimica Acta* 73:5918. [5] Mittlefehldt D. W. et al. 2013. *Meteoritics & Planetary Science*, submitted. [6] Cartwright J. A. et al. 2013. *Geochimica et Cosmochimica Acta* 105:395.